

Mobile 3D Capture for Professional Applications



TECH TALK BY RAFAEL SPRING

Co-Founder & CTO at DotProduct

OUTLINE

1. *3D Capture Applications*
2. *DotProduct Technology*
3. *Sensors*
4. *Outlook and Trends*

3D Capture Applications

CONSUMER USE-CASES

AR/VR Pose Tracking

Mixed Reality

3D Content Creation

Autonomous Cars

(Some) IoT

PROFESSIONAL USE-CASES

AEC: As-built, Planning,
Documentation, Verification

Asset Management, IoT

In-Field Intelligence

Reverse Engineering

Forensics / Law Enforcement

PRO-SUMER USE-CASES

DIY, Repair

Home Improvement

PROF. USE-CASES (CONTINUED)

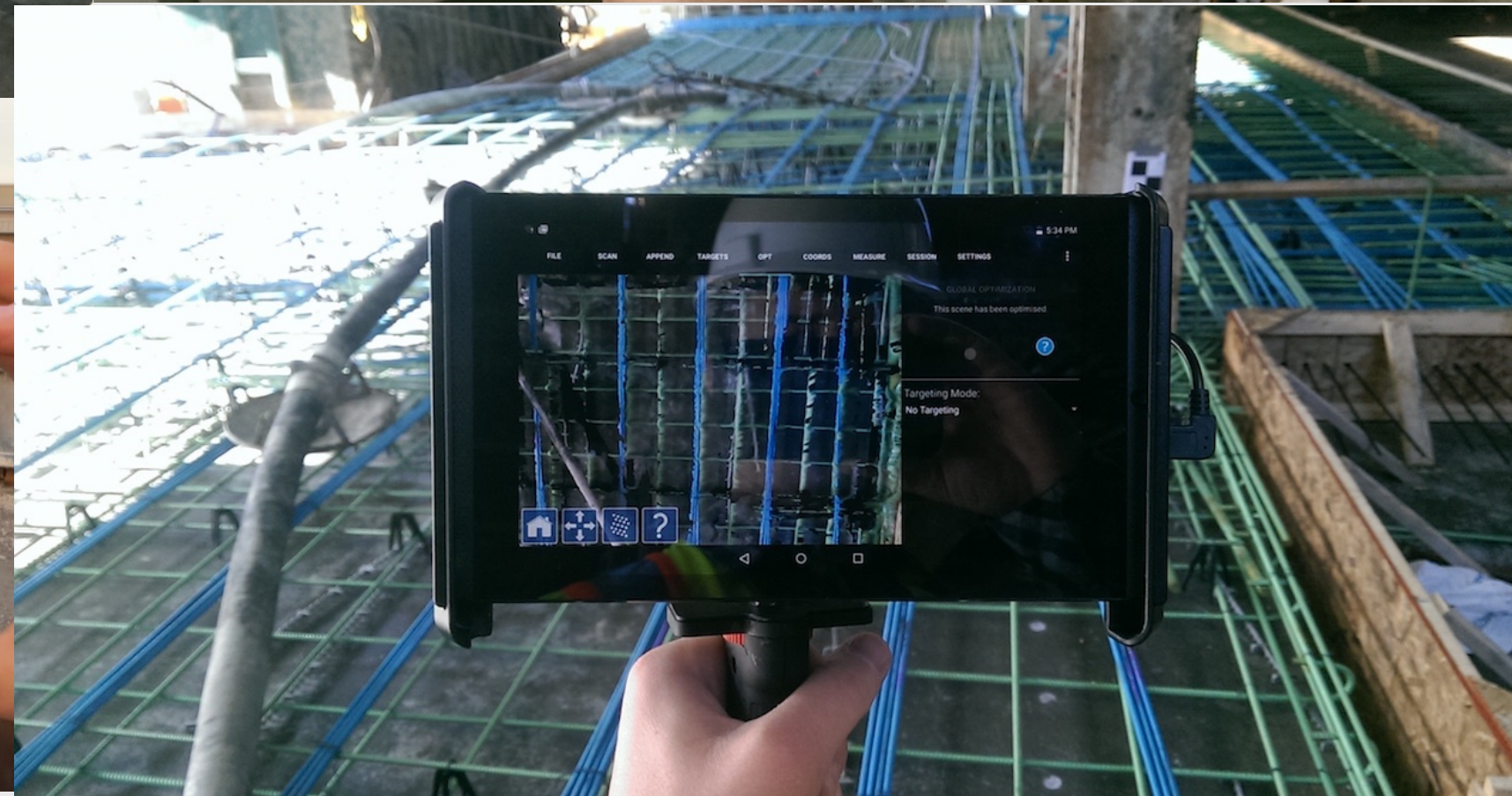
Geo / Mapping / Surveying

Archaeology / Heritage

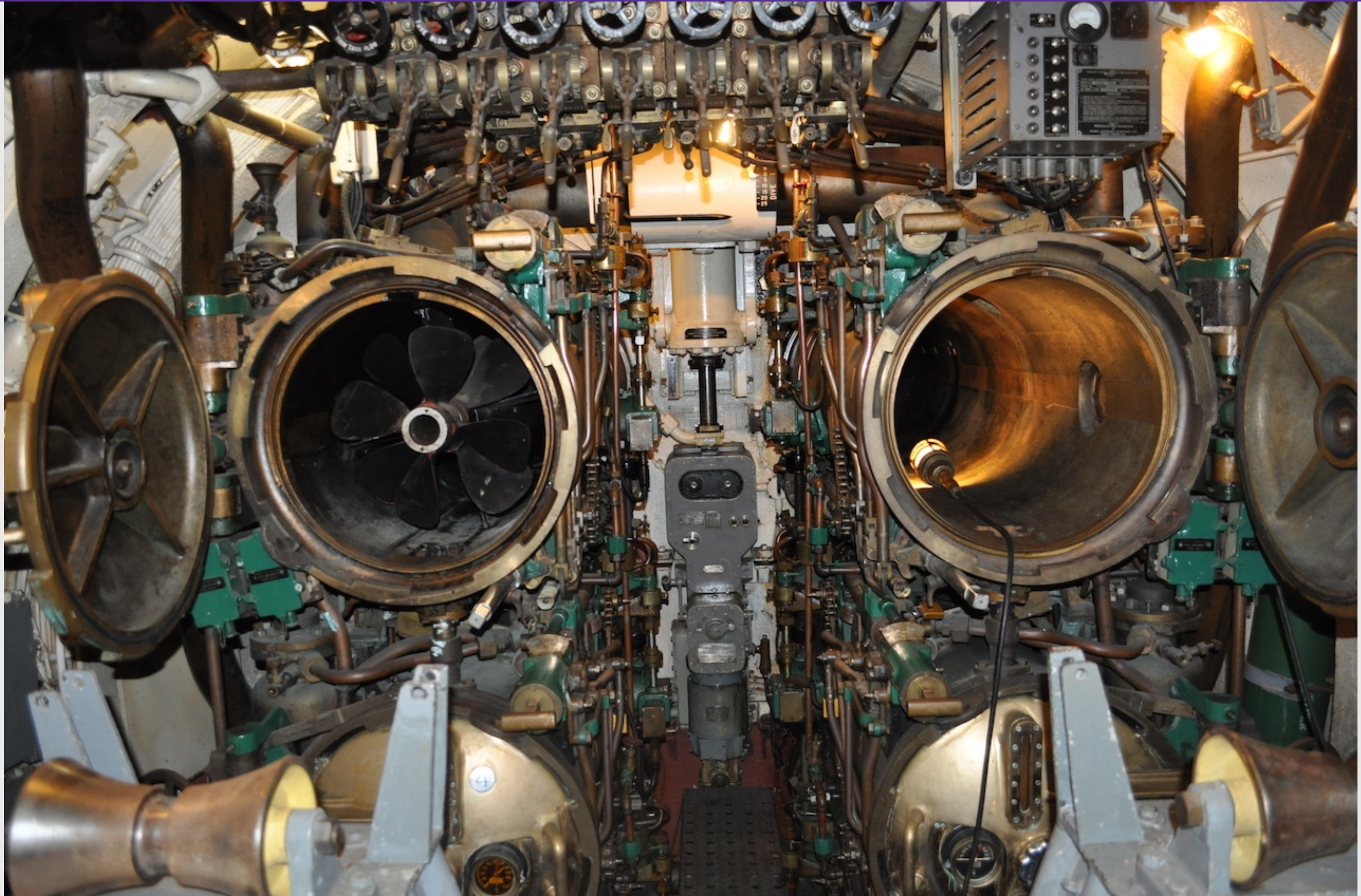
QA/QC, Inspection

Movies & Entertainment Prod.

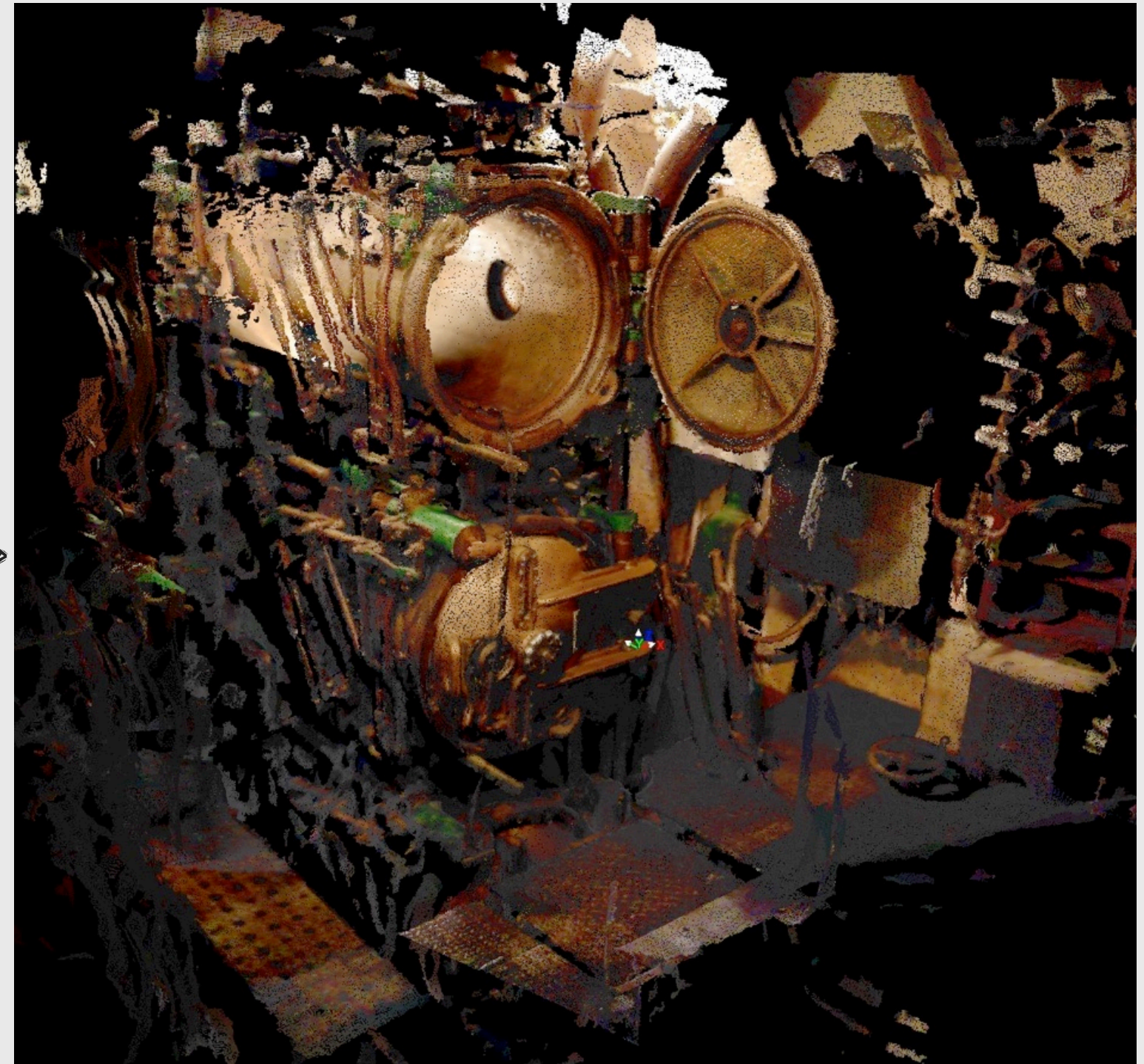
3D Capture Applications



3D Capture Applications



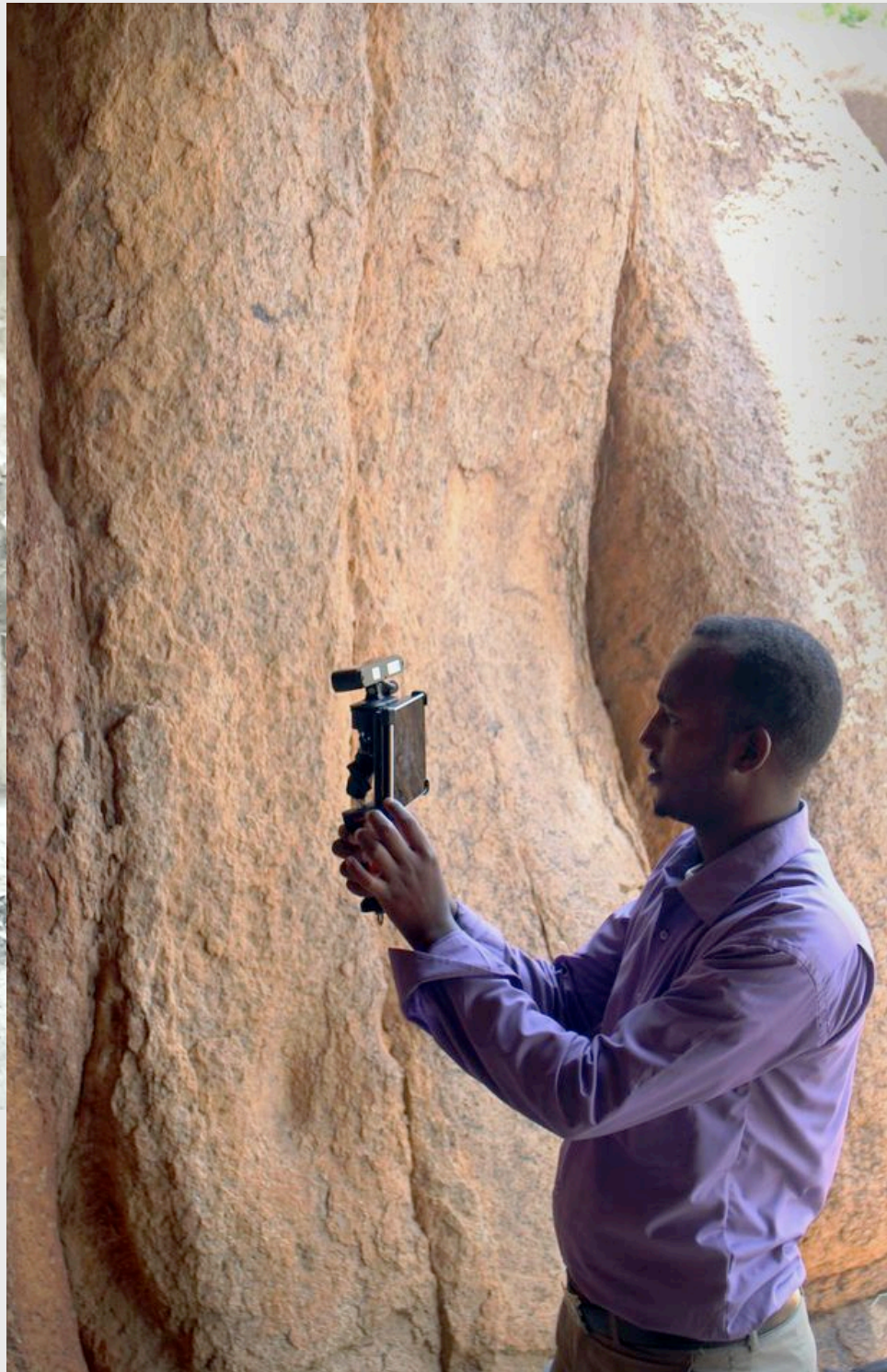
3D Capture Applications



3D Capture Applications



3D Capture Applications



MISSION AND CORE STRENGTHS

Mission: Make 3D capture accessible and usable at scale to solve real-world problems.

- Industry-leading, patented mobile 3D capture product.
- Many years of experience with customers from professional / industrial space.
- Solving real-world problems with real 3D work-flows.

DOTPRODUCT USE-CASES

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Archaeology / Heritage

Pro-sumer

DotProduct Technology

DOTPRODUCT TECHNOLOGY STACK

DotProduct Verticals

3rd Party Verticals

Front End(s) (QML, Java)

SDK / API

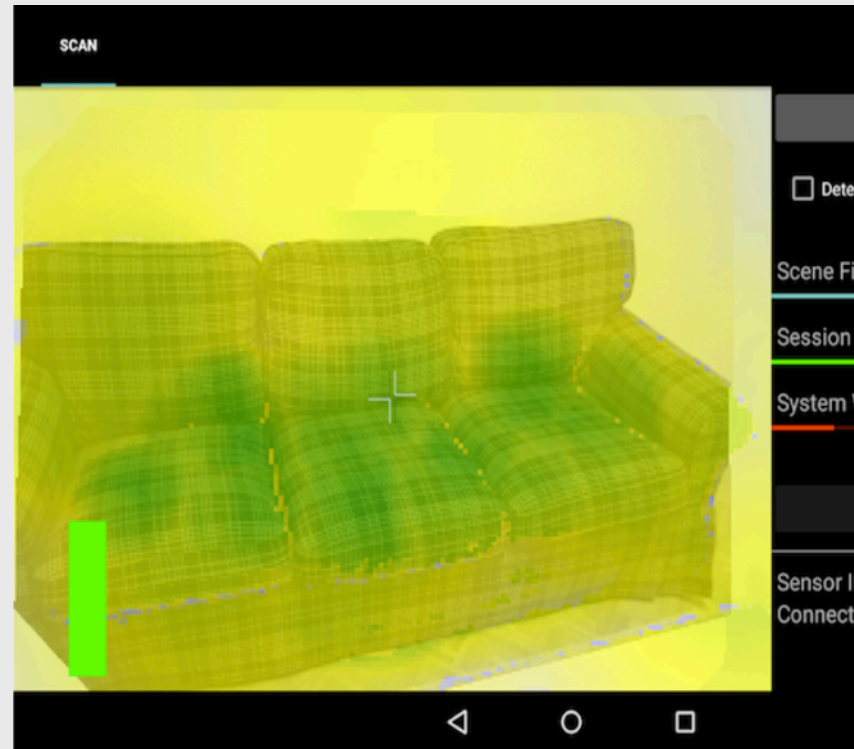
DP Core Engine (C++, GPGPU)

Sensor Abstraction Layer (C++)

3D Sensors

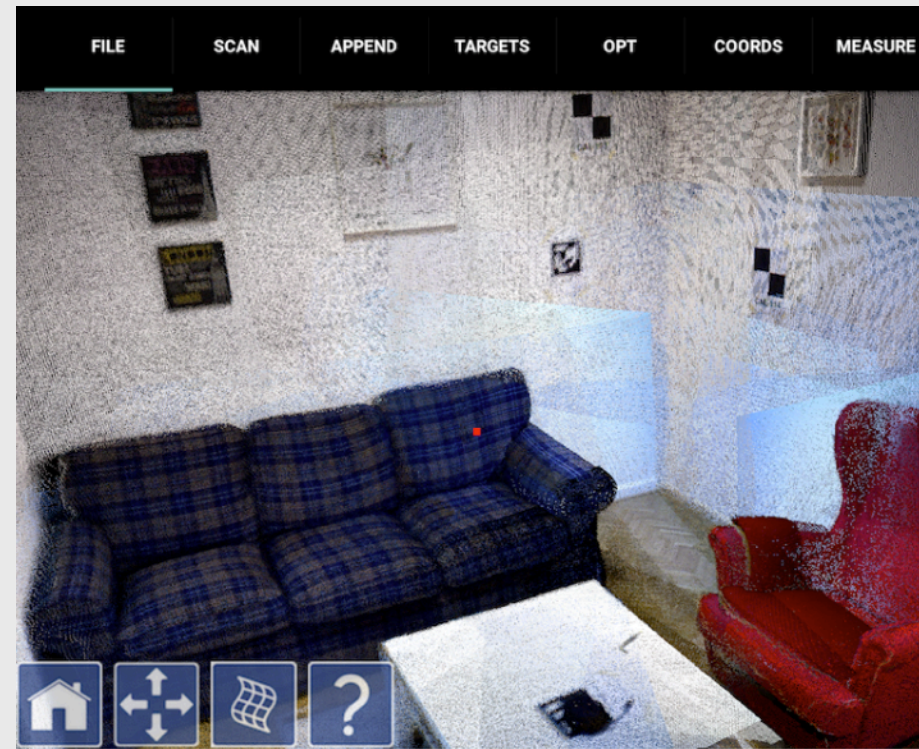
Computing Hardware

1. CAPTURE



FINISH CAPTURING

2. PREVIEW



**GLOBAL OPTIMIZATION
(AUTOMATIC)**

3. FINAL MODEL



Architecture

Separation between:

Online (Realtime) Part:

- Capture
- Feedback (about Quality, etc ...)
- User Guidance

“Preview”

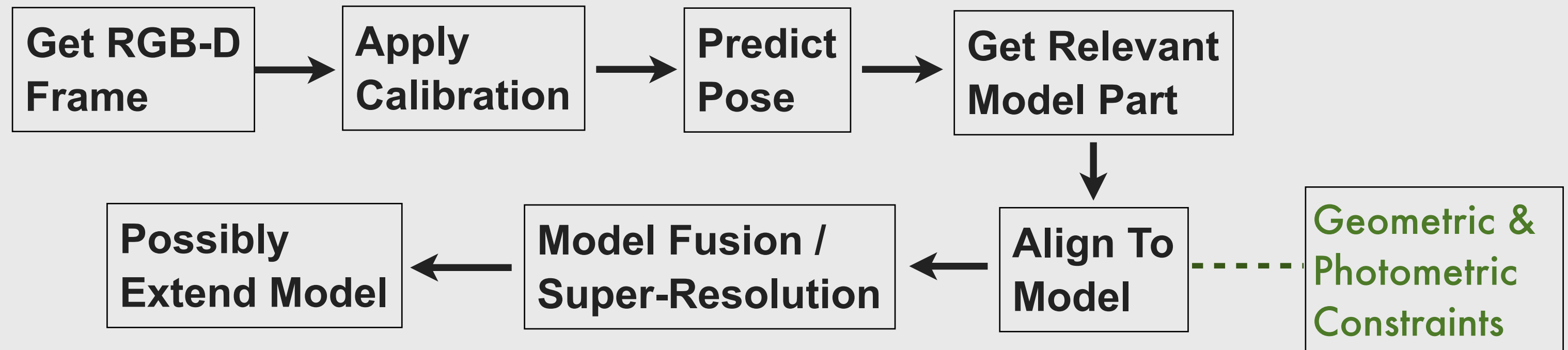
Offline (Post Prc.) Part:

- Global Optimization (with possible constraints)
- Surface Reconstruction / Meshing

Final Result

Architecture

Online (Realtime) Part Overview:



In parallel:

Tags- and loop-detection,
Map simplification / streaming

Architecture

Also part of the DotProduct Core:

- Failure-aware tracking and re-localization.
- Compressed Point Cloud File Format.
- Targeting, multi-constraint optimization.
- Point-level precision information.
- Image-based Rendering.
- Append. Ability to add data to an existing model.
- Sensor- and platform-independence.
- All on-device (cloud-free).

Sensors

Sensors

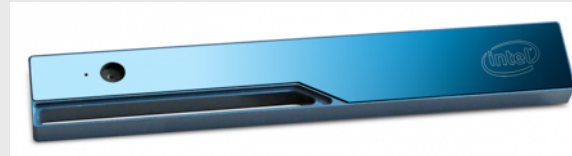
2D CAMERA



+



SL / STEREO



TOF



LIDAR



OTHERS

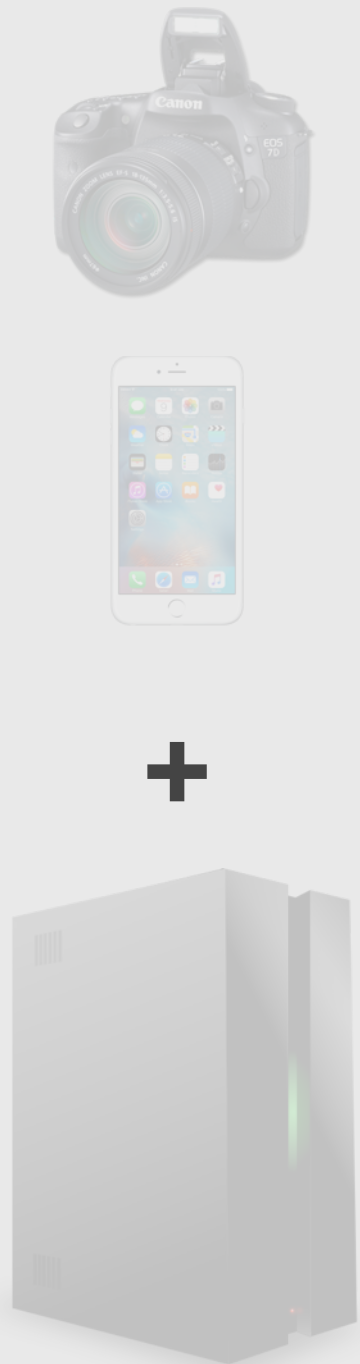


Many 3D sensors today are **tailored** to → Vertical Ecosystem a specific use-case!



Sensors

2D CAMERA



SL / STEREO



TOF



LIDAR



OTHERS



PRODUCT REQUIREMENTS

- Accuracy, Stability, Reliability
- Rugged
- Capture outdoors / in daylight
- Easy to use
- Good quality at long ranges
- Cover spaces quickly

DOTPRODUCT USE-CASES

AEC: As-built, Planning, Work Documentation and Verification

Asset Management, Synchronization, IoT

In-Field Intelligence

Forensics

Archaeology / Heritage

Pro-sumer

PRODUCT **NON**-REQUIREMENTS

- Polished **looks**
- **Small** form-factor / integrated
- **Cheap** price point

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3D SENSOR PROBLEMS WE'RE DEALING WITH TODAY

Rolling Shutter

Geometric Undersampling

Small FOV

Surface / Lighting Issues

Depth Distortions

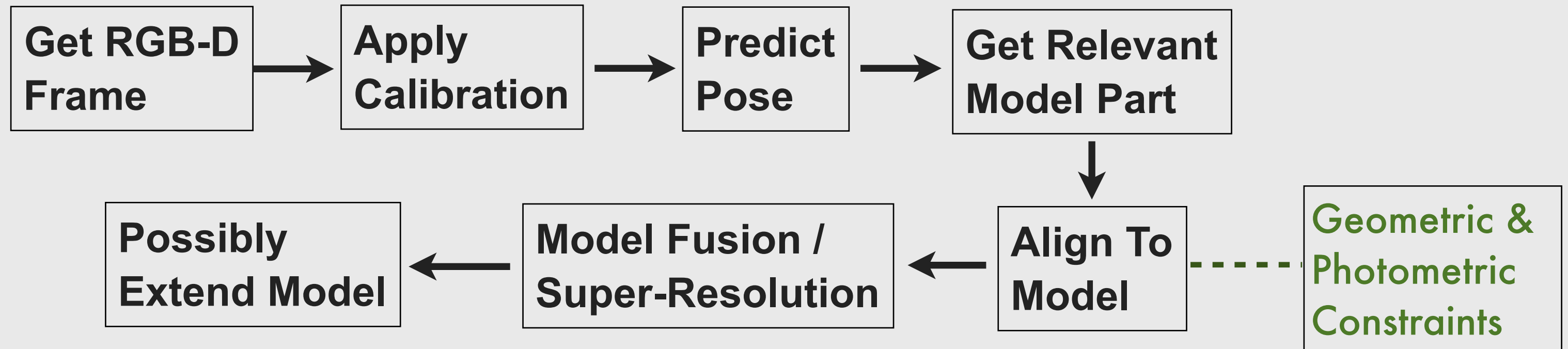
Instabilities

Registration / Sync Issues

Motion Blur

Architecture

Online (Realtime) Part Overview:



In parallel:

Tags- and loop-detection,
Map simplification / streaming

Sensors

Registration and
Sync Issues



Get RGB-D
Frame

Depth Distortions,
Rolling Shutter,
Motion Blur,
Instabilities,
Lighting Issues,
Undersampling



Model Fusion /
Super-Resolution

Depth Distortions,
Rolling Shutter,
Motion Blur,
Small FOV,
Instabilities



Align To
Model

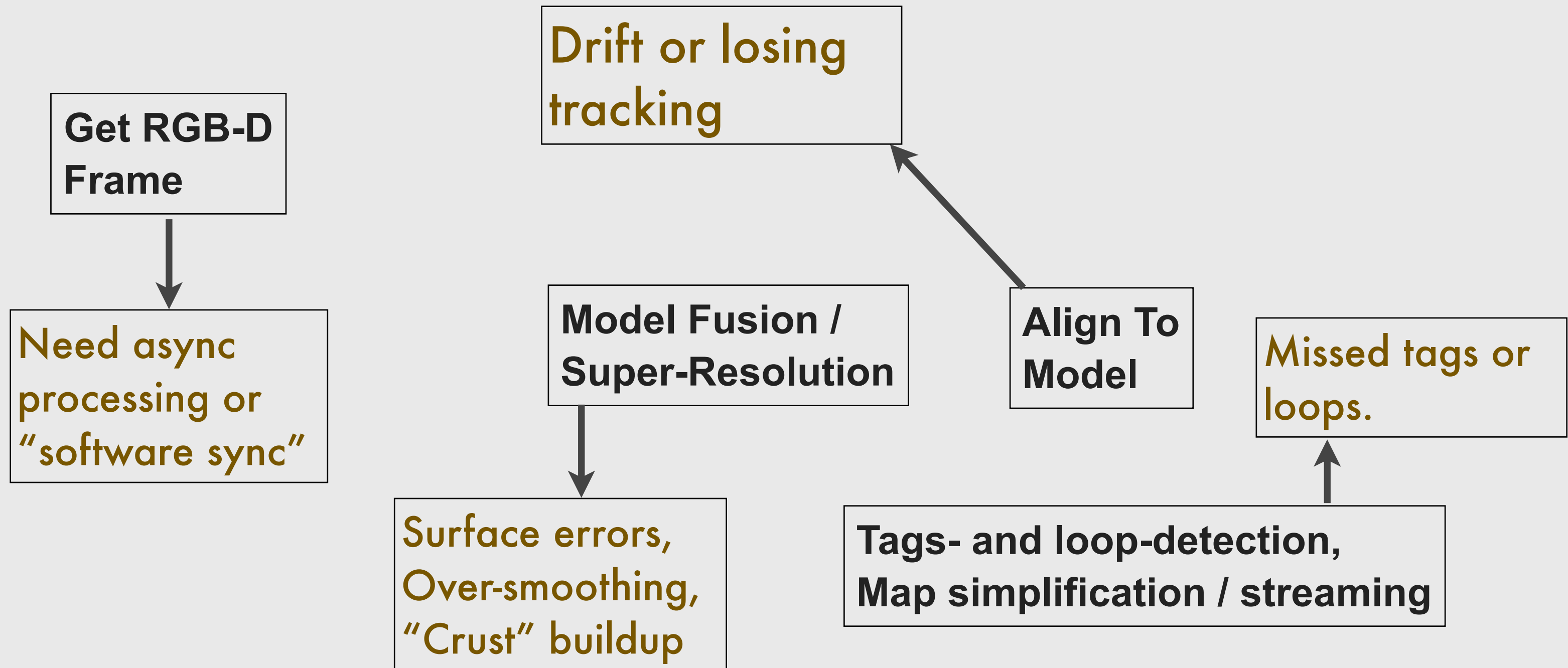
How **sensor issues**
affect capturing

Motion Blur,
Small FOV,
Low Range,
Lighting Issues

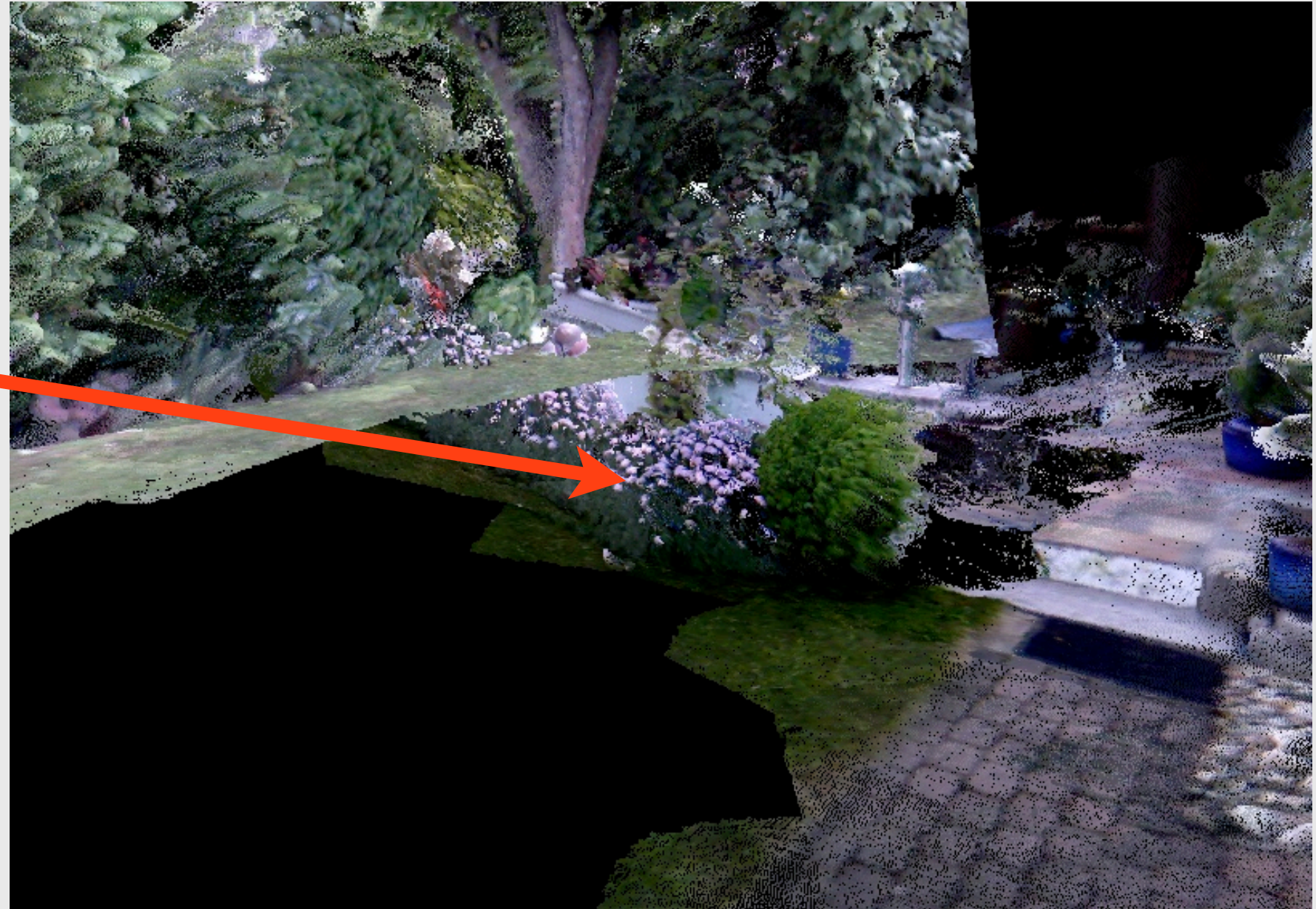
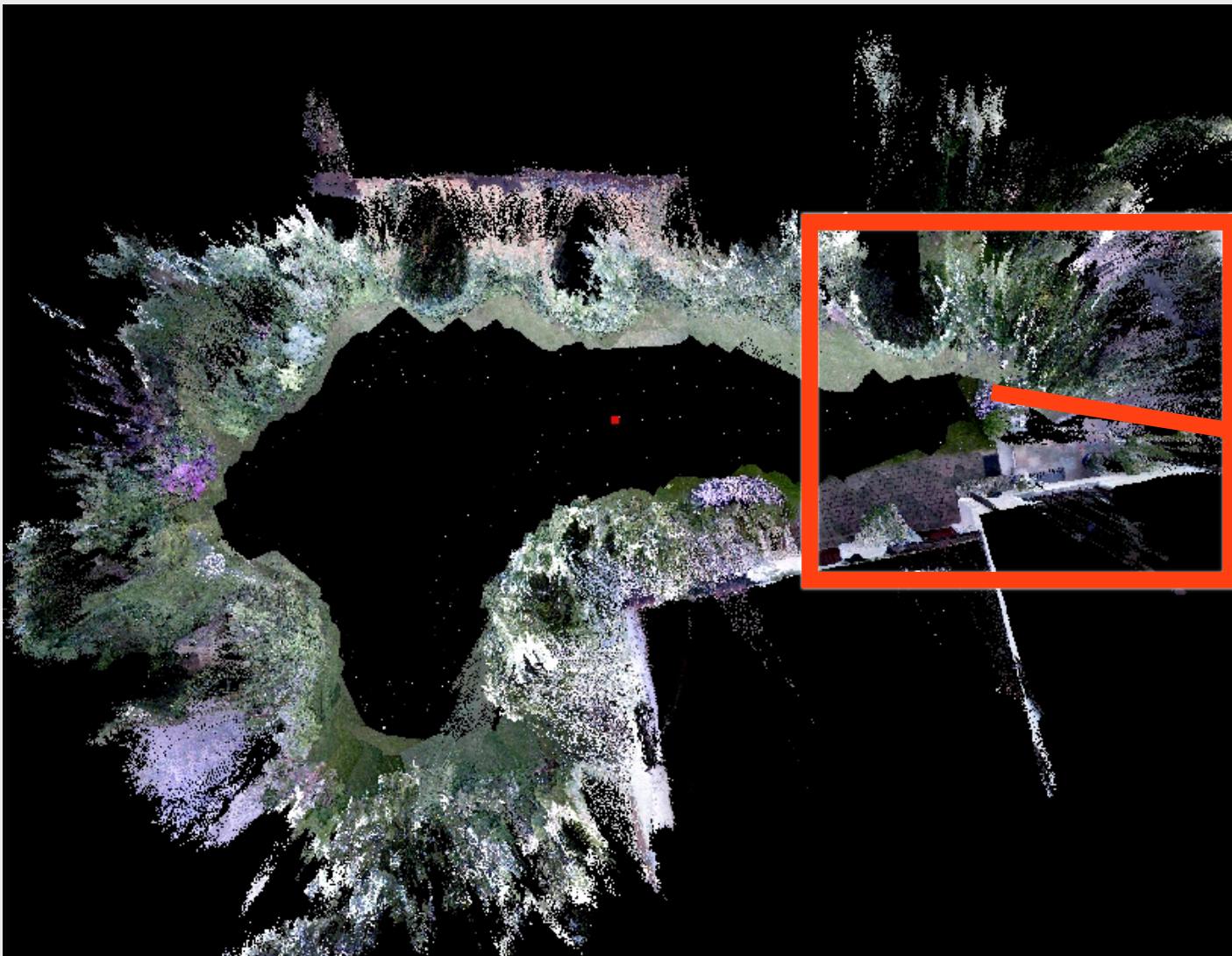


Tags- and loop-detection,
Map simplification / streaming

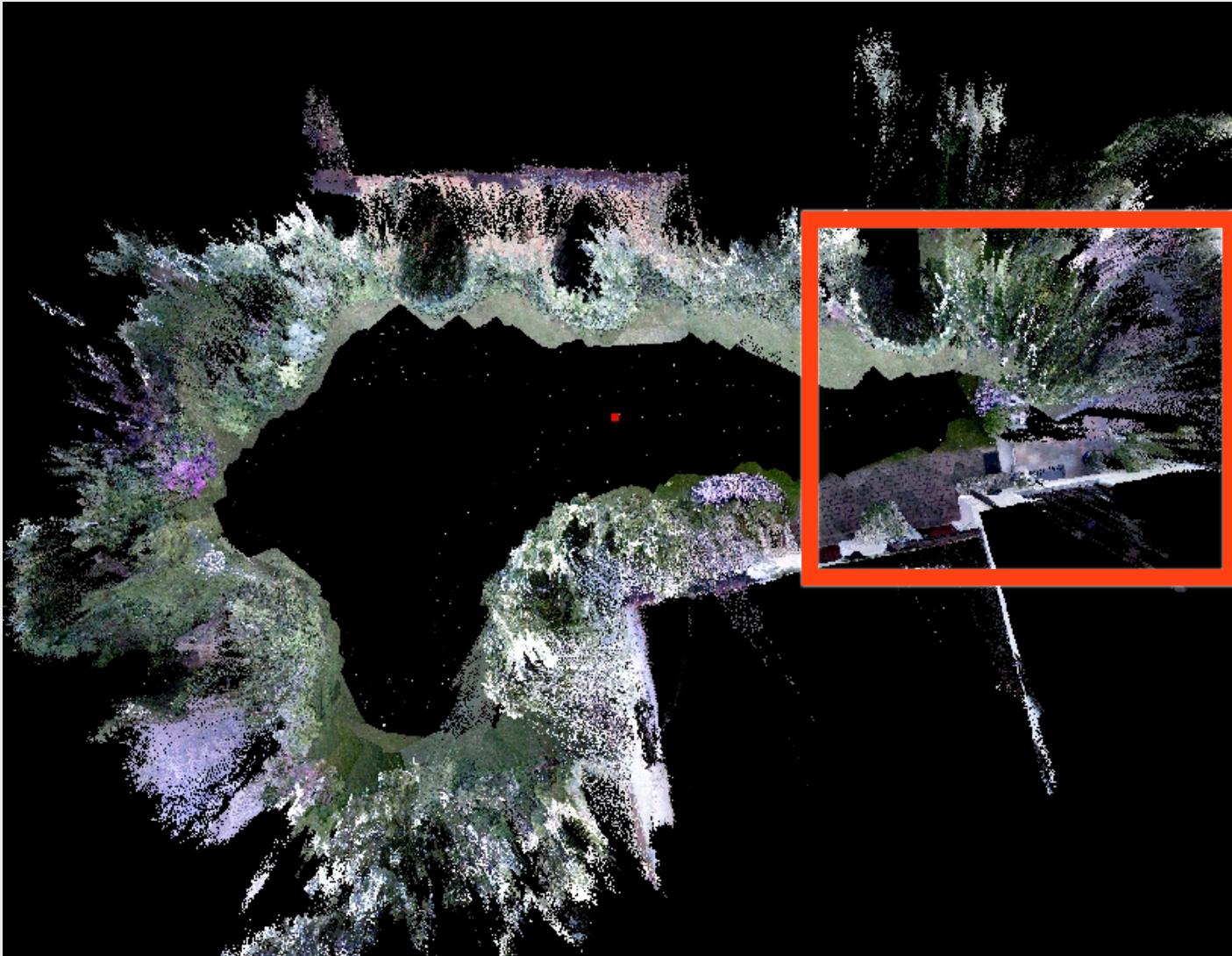
Sensors



DRIFT / LARGE LOOPS

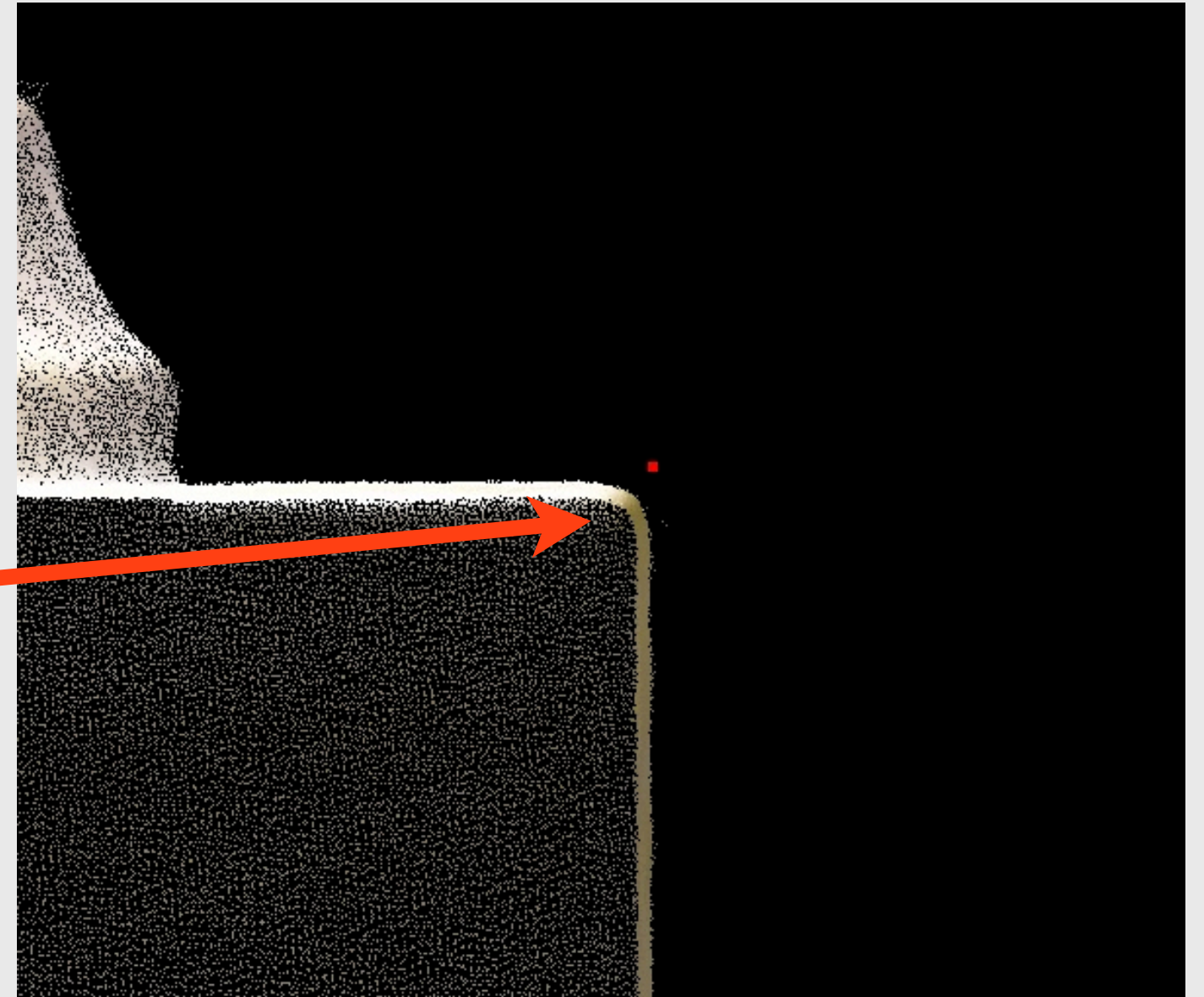
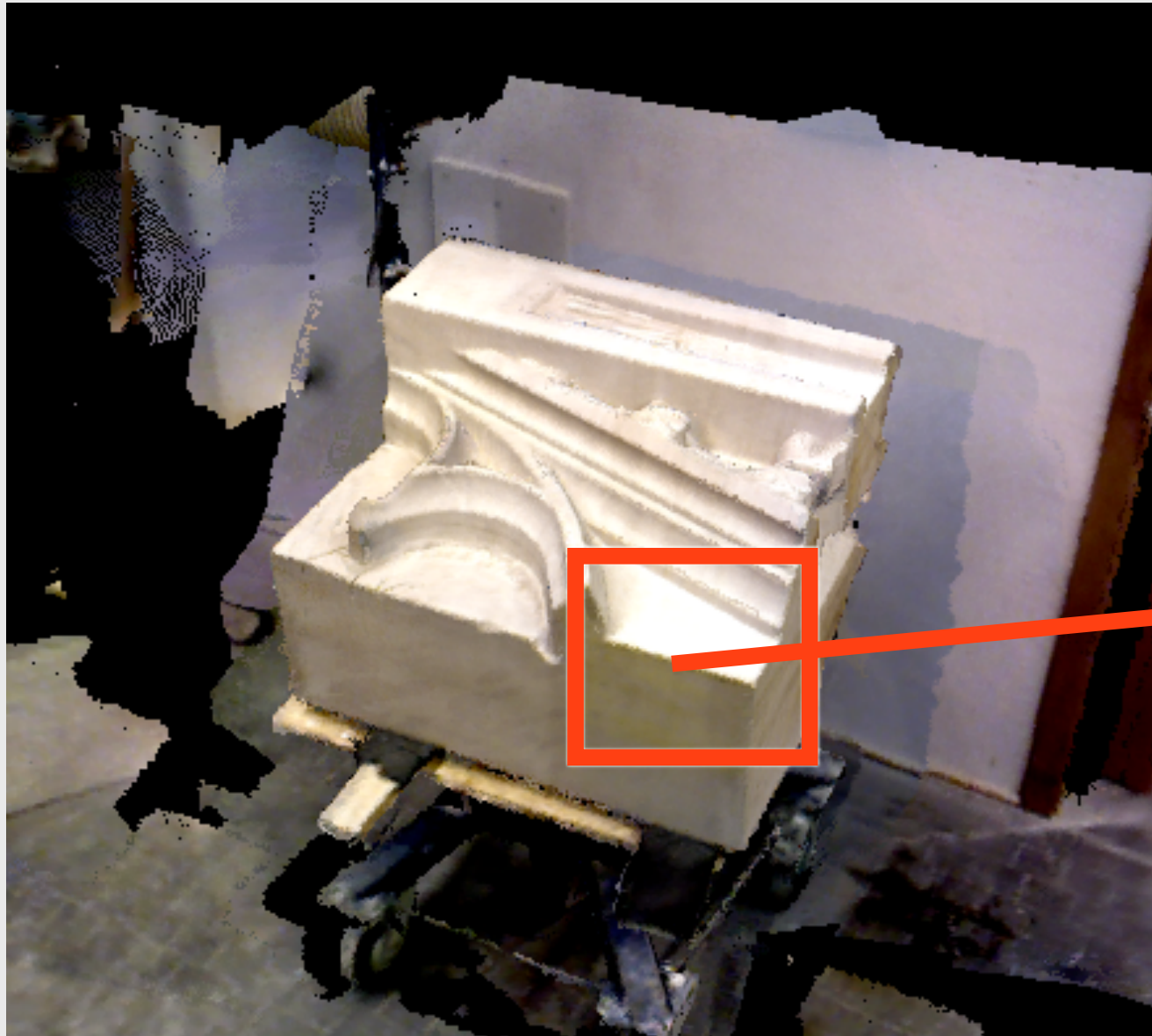


DRIFT / LARGE LOOPS



Drift is mostly due to sensor distortion in the depth image, not so much because of high-frequency noise.

OVER-SMOOTHING



LOW-RES COLORS



What we would like

A partner who builds an affordable, reliable RGB-D sensor **at scale**, without the problems that plague current consumer sensors.

- ▶ All the sensor technical problems are basically solved. It's a business problem now.
- ▶ Many are competing for the consumer market but 3D capture for Enterprise is still wide open!

Outlook & Trends

Trend #1: 3D sensors are going to become *much* better.

- ▶ What's needed is investment and execution to go from lab to real-world application.

Interesting developments:



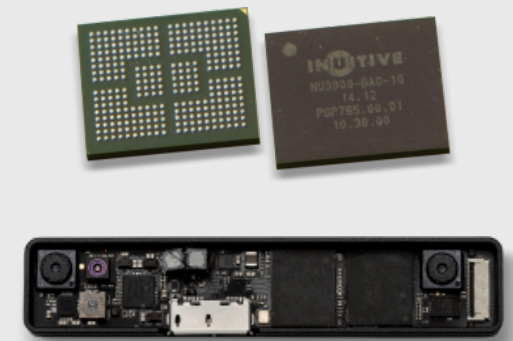
SOLID-STATE LIDAR



PHOTON-X



MANTIS VISION F5

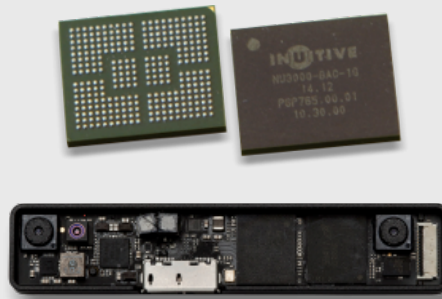


STEREO-ON-A-CHIP

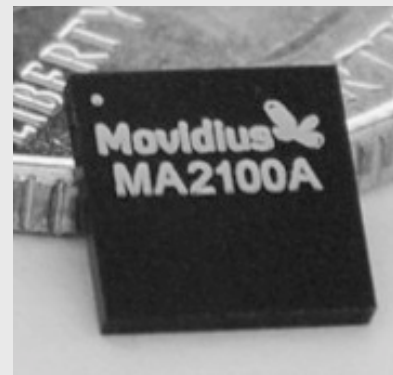
Trend #2: Low-power compute.

- ▶ We have enough compute performance today. The future is lowering the power consumption.
- ▶ The challenge is finding a balance between universality and use-case optimization.

Interesting developments by:



INUITIVE TECH



MOVIDIUS



Trend #3: A flood of 3D data.

- ▶ With 3D sensors and low-power compute becoming ubiquitous, the amount of generated 3D data will explode.
- ▶ The next frontier will be creating systems that can handle this flood of data intelligently.
- ▶ In professional domains 3D mapping will be replaced by a 4D “digital twin”.

Interesting developments by:  **DOT PRODUCT**

Thanks! Questions?

Or write me an email: rafael@dotproduct3d.com

